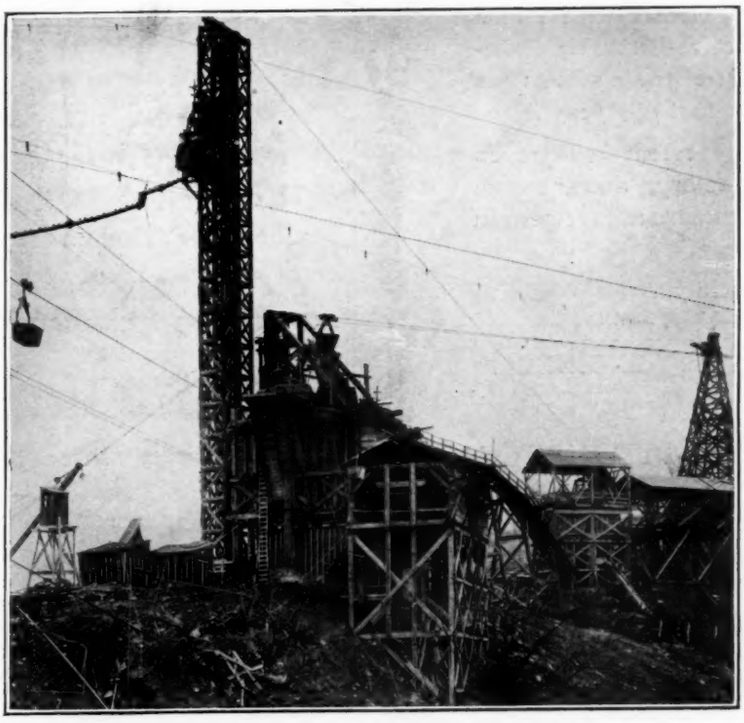
PUBLIC WORKS

CITY COUNTY STATE



GILBOA DAM: CONCRETE PLANT WITH HOISTING TOWER, AND AERIAL TRAMWAY FOR AGGREGATE

IN THIS ISSUE:

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PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Vol. 52 April 29, 1922 No. 17

Gilboa Dam Construction*

Quarries, sand pits, washing and screening, concrete mixing and placing.

Stone for concrete and for ashlar masonry is derived from the excavation for the main dam and from the Riverside and Stevens Mountain quarries. Most of the cyclopean stone is excavated at the dam site and is handled by the main cableway there. The concrete stone, excavated at the same place, was at first handled by steam shovels, dump cars and steel derricks, which were afterwards superseded by the main cableway that receives the stones in large skips and dumps them into a loading hopper, delivering to 4-yard cars, which run down-grade on a wooden trestle 70 feet long and are carried above the spoil bank, where the waste is deposited, to a Number 5 gyratory Austin crusher installed at the Churchill plant. The crusher is served by a stiff-leg derrick with 45-foot boom. It is driven by a 60-horse power electric motor and is served with two 24-inch belt conveyors, 190-feet and 210-feet in length.

The cableway has two 150-foot wooden towers suporting the 1,900-foot cableway span that is equipped with a 2½-inch cable, 2,600 feet long, ¾-inch cable 2,800 feet long, 92 carrier blocks and 2,500 feet of ⅜-inch chain and one spreader bar with hooks, and one signal tower. It is operated by one 300-h.p. electric motor. In addition to the cableway, the dam is equipped with four steel guy derricks having 150-foot masts and booms, two traveling derricks with 37-foot masts and 75-foot booms, and one traveling derrick on the spillway with a 40-foot mast and a 75-foot boom. The derricks are operated by four Lambert 52-h.p. electric engines, and two Lidgerwood 2-drum engines. The foundation was kept dry by means of one 6-inch Warner steam duplex pump, one 6-inch and one

*Part I, Exploration Borings, pressure tests, river diversion, foundation excavation, installation of plant was published March 25.

SAND SCREENING AND WASHING PLANT.

3-inch Worthington steam duplex pump, and one 6-inch centrifugal electrical pump.

STONE QUARRIES

The Riverside quarry produces a good quality of sandstone traversed by vertical and horizontal seams that enable it to be taken out in blocks 5 or 6 feet thick with very little blasting, the required sizes being obtained by drilling and plug-and-feather work. The quarry is equipped with one stiff-leg derrick and two grey derricks, operated both by steam and air, and there is installed there an air-driven planer to dress the faces of the edge stone. About 1,500 yards of stone were quarried during the season and most of it was delivered to the dam by trucks or teams which will be superseded by cars operated on a narrow-gage railroad that has been constructed from the quarry to the dam.

A large amount of stone is quarried on Stevens Mountain, where the soil was stripped from the ledge rock by an hydraulic monitor operated at 140 pounds nozzle pressure. The water was pumped by two 10-inch double-phase and one 10-inch single-phase Lee-Courtney electrical centrifugal machines at the rate of 1,900 gallons per minute delivered through a 10-inch spiral pipe line extending from the Manor Kill to the quarry site. From June 1 to August 1 about 4,000 yards of earth were removed by the monitor. A cyclone well drill with a capacity of drilling 40 feet of 6-inch holes in 8 hours has been installed at the quarry and the stone is loaded by a steam shovel into 4-yard side-dump cars operating on a narrow-gage track leading from the quarry to the crusher.

At the quarry there are intsalled one 42x48-inch jaw crusher and two gyratory crushers. A stone aerial tramway 3,670 feet long has ten intermediate towers 22 feet high, a 1¼-inch cable 4,100 feet long, 1⅛-inch cable 4,100 feet long, a ¾-inch cable 7,500 feet long and 32 buckets with a capacity of 1 1/9-cubic yards each. To operate the tramway and the quarry machinery there are installed ten electric motors of from 5 to 150 h.p.

SAND PITS

All of the sand used was from local deposits of glacial drift, most of it being finer than was considered most desirable, but otherwise of satisfactory quality. Small quantities of sand were derived from the Cherry Knoll pit and from the river flats along the creek below the Schoharie bridge. The main supply is situated near the intake about 2¾ miles from the dam, with which it is connected by a narrow-gage railroad. The sand in this pit varies from coarse gravel to fine sand with pockets of clay, and is excavted with a Thew steam shovel that loads into 4-yard dump cars hauled in trains of six to the sand-washing plant at the dam site. The sand cars are hauled over the 4,000 feet of narrow-gage railroad by an 18-ton dinky locomotive.

At the sand-washing plant the sand is dumped through a hopper to a grizzley that feeds a 24-inch belt conveyer 150 feet long that is driven by a 30-horse power electric motor. The conveyor carries the sand up an incline to a revolving screen with ¼-inch openings through which the sand is washed by a constant stream of water and is conveyed through wooden flumes to settling cones with automatic bottom valves through which the acceptable sand is drawn off, while the dirt and fine sand overflow with the water at the tops of the cones. The coarse material is rejected from the end of the revolving screen and the washed sand is delivered to buckets and transported to the concrete mixers by 1¼-yard buckets operated on the aerial tramway 560 feet long, at a speed of 500 feet per minute. The tramway has a 1¾-inch rope for the loaded buckets and 1¼-inch rope for the empty buckets, both of which are supported with a single intermediate tower. About 600 gallons of water per minute is required for washing the sand. The tramway is operated by a 30-h.p. electric motor.

MAIN STONE CRUSHER PLANT

The Stevens Mountain quarry crusher plant is equipped with a Traylor 42 x 48-inch Bull Dog jaw crusher set on a concrete base near the end of a 300-foot trestle which carries the railroad track from the quarry. From this crusher the stone passes to a No. 16 Traylor gyratory crushes that delivers to a 200-foot belt conveyor serving the screen and discharges into the storage bin. From the storage bin it is chuted to a boom belt conveyor 90 feet long that discharges to storage pile. Tailings are crushed in a No. 5 Traylor gyratory crusher, and delivered by a bucket conveyor to the screen. The screenings are delivered by a belt conveyor to a separate storage pile.

All of the equipment in this plant is electrically operated, and it has a capacity of 150 yards per hour. The storage pile is located over an 8x8-foot wooden tunnel 180 feet long, through which two 2-yard cars are hauled by a hoisting engine to the storage bins.

The storage bins deliver by gravity to 32 one-yard buckets spaced 250 feet apart on an aerial tramway 3,670 feet long that is operated at a speed of 500 feet per minute to deliver the stone to the concrete mixer. The tramway has 10 towers supporting the 1¾-inch cable for the full buckets and the 1⅛-inch cable for the empty buckets. The lower end of the tramway is located near the Churchill crusher and delivers the broken stone to the belt conveyer, depositing it in storage bins over the mixer.

The cement storage house, with a capacity of 18,000 bags, delivers to the 2,000-yard storage room under the concrete mixer by means of 18 buckets each of 6-bag capacity, spaced 400 feet apart on the 3,300-foot long aerial tramway that has a 1¼-inch cable for loaded buckets and ⅞-inch cable for empty buckets, and that travels at a speed of 500 feet per minute. The cables are supported on eight intermediate towers of an average height of 18 feet, and their drums are operated by a 40-h.p. electric motor.

CONCRETE PLANT

The main concrete mixing plant, located centrally, receives the cement, sand and broken stone from the tramways. It is equipped with a 56-cubic foot capacity Lakewood drum mixer driven by one 82-h.p. electric motor and supplied by gravity with sand and stone from overhead bins with capacities of 290 and 340 yards, respectively, the cement being delivered from below by an elevator. The concrete is discharged into two elevating buckets in the hoisting

tower, which deliver into a receiving hopper in the top of the tower, where it is spouted to position in the dam.

The double-shaft hoisting and boosting towers are respectively 168 and 150 feet in height and are connected by a 430-foot span cableway, from which are suspended 14-inch concrete chutes. The four hoisting buckets are of 2-yard capacity and are handled by two Lakewood double drum hoisting engines driven by electric motors. The chutes are inclined at a slope of 1 on 2¾. The concrete is proportioned 1:2.52:5.04 and is mixed with the minimum quantity of water necessary to provide for its flow through the chutes. It is made with Nazareth and Whitehall brands of cement and is mixed with water delivered through a 4-inch gravity pipe line laid by the contractor.

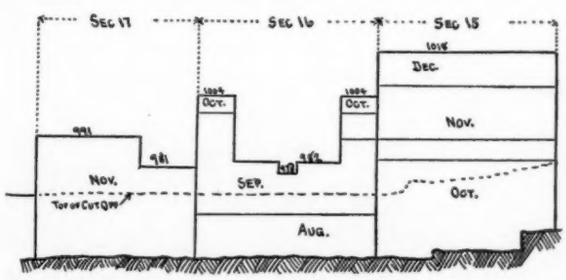
During the latter part of August peculiar behavior of the concrete was noted, in that the surface of the concrete exhibited a network of cracks two or three inches deep appearing two or three hours after the concrete was laid. Varying the proportions of sand, water and stone did not prevent the cracks, but they were finally avoided by keeping the surface of the concrete thoroughly sprinkled with water until after it had attained its final set.

CYCLOPEAN MASONRY

Concreting for the foundations of the main dam was commenced August 10, 1921. In section No. 16 it was laid in very irregular masses 75 feet long between contraction joints. The concrete was at first mixed in a ½-yard machine operated until August 16th, when the 2-yard machine in the main concrete plant was put in service and delivered through the steel chutes already mentioned. Water control was completely effected on August 25, when the concreting in the cutoff trench was commenced and as fast as successive areas of the foundations were prepared, the concrete was built up in them in sections separated by vertical contraction joints and maintaining an offset longitudinal elevation as indicated in the accompanying sketch.

The rock strata were very irregular and lying at various angles intersected by seams and fissures in different directions, making a dovetailed mass of angular fragments with considerable water entering through the seams. This leakage was collected in sumps, drained by a 4-inch longitudinal pipe laid in the bottom of the cutoff trench.

The contraction joints are generally 76 feet apart extending in vertical planes across the full width of the dam and sealed by a flexible 7 x 1-16-inch vertical copper strip 15 feet from the dam line that has



MONTHLY PROGRESS OF CYCLOPEAN MASONRY ON GILBOA DAM, 1921.

both edges firmly imbedded in the concrete of the adjacent section. Originally the contraction joints were made against steel forms, but these were afterwards replaced by plain wooden forms, and rough wooden forms are used for other portions of the concrete surfaces. The section of the dam that contained the two 9-foot by-pass pipes was only 35 feet between joints.

The cyclopean stones are handled by the main cableways and the face stones are usually set in advance of the concrete so as to act as forms. The blocks are bedded in 1:2½ mortar joints with the joints raked out to a minimum depth of 2 inches. The tread stones are grouted with 1:1 mortar before work is begun on the rises. The edge stones are anchored back to the cyclopean masonry by 1½-inch round rods not more than 5 feet apart, with eyes engaging anchor pins.

GROUTING

The foundation of the cutoff trench was grouted through a line of 2-inch diamond drill holes, in the tops of which pipes were set and extended as the masonry was brought up. The bottom for section 18 was badly seamed with vertical cracks and 32 grout pipes were set, subjected to 75-pound air pressure and charged with grout made with 23 gallons of water to one bag of cement, and afterwards finished with a thicker grout made with 12½ gallons of water per bag of cement. In all 213 cubic feet of grout were used for these holes.

New Jersey $40,000,000 State Highway Bill

New Jersey State Highway Bill introduced January 10, 1922, referred to the Committee on Judiciary and eventually passed by the Legislature, has been vetoed by the Governor, but passed over his veto and will be submitted for general vote at the next fall elections.

The bill provides for the issue of bonds not to exceed $40,000,000 for the purpose of paying the cost of construction, improving, reconstructing and rebuilding the main highway system as now authorized by law, or portions thereof, including bridges. The bill carries provision for a state tax of not less than one mill on the dollar of the assessed value of real and personal property during the years 1923-1927, inclusive. It is estimated that $30,000,000 will be required for road building bonds of a maximum life of 20 years and that $10,000,000 of bonds with a maximum life of 15 years will be required for bridges.

The plan is expected to provide for issuing not more than $8,000,000 worth of bonds per year for the next five years and to furnish a sinking fund for retiring the bonds and a surplus, which it is estimated in 1927 will be more than $3,000,000, applicable for the reimbursement on commitments that the State Highway Department has made with counties and municipalities and which in future would not be made.

By this arrangement the State system would be completed in five years and first class roads would be provided at an early date, instead of being delayed from 12 to 15 years under the present high-

way system. The repairs and upkeep of the old roads and bridges under the present highway system cost about $4,000 per mile for 500 miles; when reconstructed according to the plans the upkeep cost will be less than $500 per mile annually, showing a saving of more than $1,750,000 yearly, which will be available for distribution to the counties for aid in the maintenance of county roads.

Rapid Construction of Concrete Road

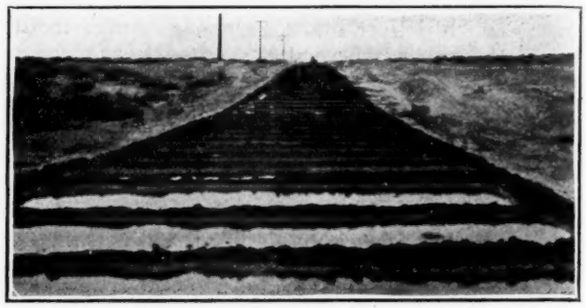
Seven and a half miles of eighteen to twenty-foot road laid in a desert country in fifty-four days.

Road district improvement No. 12, 7.6 miles long from Lokern to McKittrick, Kern county, California, was paved last fall by Rogers Bros. Co. of Los Angeles, for a contract price of $348,700, the work being completed in 54 calendar days, commencing September 1st and finishing the concreting November 24th, after which the shoulders were finished and the work accepted December 12th.

The pavement was 7 inches thick and varied in width from 18 feet to 20 feet, increased sometimes on curves to 24 feet.

The location was in a dry, sandy, hilly, desert country with grades from 2 to 6 per cent and curves up to 6 degrees. The 1:2:4 concrete was reinforced over fills. The grading was done with Fresno scrapers. The aggregate was delivered by rail, and unloaded by clam shell buckets at two storage yards at the opposite ends of the route, from which the average haul was 2¾ miles for one paver and 2 miles for the other paver. Multifoot 21A mixers were used.

AGGREGATE DISTRIBUTED AHEAD OF PAVER



PONDAGE CURBING ON A GRADE

Two camps were established, one for each paver and built respectively 4 1/2 miles of road from the Lokern camp and 3 miles from the McKittrick camp.

Crew No. 1 constructed pavement 18 feet wide on the tangent and from 3 to 5 feet wider on curves. The best day's run, on November 11th, was 695 linear feet, equal to 270.7 cubic yards. The best five consecutive days' run averaged 643.4 linear feet or 250.21 cubic yards per day. The best 20 consecutive days' run averaged 546.65 linear feet or 230.11 cubic yards and included three days when no work was done, one day when the waterline broke and one day when the cement supply failed.

The No. 2 mixer crew laid 9,000 linear feet of pavement 18 feet wide and 7,600 feet of pavement 20 feet wide, almost all of the latter being laid on 6 to 6½ per cent grade with curves superelevated from 2 to 3 feet and located in the mountains where no detour roads were provided. The best day's run was 692 linear fet, equal to 269.11 cubic yards of 18 x 7-inch roadway, on November 1st. The best five consecutive days' run averaged 631 linear feet or 245.39 cubic yards. The best record for 20 consecutive days averaged 559.2 linear feet or 227.60 cubic yards, with four no-work days.

Water was delivered through a 7-mile line of 3-inch pipe and the pavement was cured by the pondage system. Work was done under the direction of Paul E. Pressley, consulting engineer, and Jay Jellick, resident engineer. C. C. Rogers was superintendent in charge of crew No. 1 and Hugh L. Rogers superintendent in charge of crew No. 2.

The contractor reports that during 1921 the two pavers used on this job laid respectively 20,000 and 25,000 cubic yards of concrete at a cost of not more than $152 for repair parts, exclusive of cables and minor adjustments made on the job by the crews, and no delays were caused to the work.

SERVING PAVER FROM ADJACENT STOCK PILES BY WHEELBARROW GANG.

Jefferson County's Road System

By E. M. Wheeler

Chert, gravel and "red ash" used for secondary roads, generally built by county forces. Special attention is paid to maintenance, which is performed by convicts which are kept in seven camps, twenty to sixty in a camp.

It has been the policy of the road officials of Jefferson county, Alabama, not only to build roads, but to maintain them; and not to spend money for roads, but to invest money in roads. As a result of the practical application of this policy, the road system of this county is the pride of the state and one of the best in the country.

In Jefferson county a system of main paved roads connecting the principal centers of the county and providing for the heavy traffic, are fully supplemented by a veritable network of well-constructed and maintained secondary roads, reaching into most of the smaller towns of the county and tying the main roads together at convenient intervals. Finally, the more generally used earth roads are maintained in good shape by dragging.

The activities of the department are carried on under two heads, though both are under the direction of the Board of Revenue. The engineering activities, including surveys and the supervision of contract work, are handled by C. J. Rogers, county highway engineer. The construction of the secondary roads, maintenance of them, and the care of the county prisoners is under the management of the writer as superintendent.

Jefferson county is the richest and one of the largest counties in Alabama. The county seat is Birmingham, industrial metropolis of the south, and a city of 260,000 population. At present large road construction program is being begun with the proceeds of a recent sale of $2,000,000 of road bonds, about 40 miles of paved roads being under construction, while there have been completed 61 miles of bituminous pavement laid on a concrete base, 136 miles of bituminous top road on stone base, and 253 miles of graded and charted roads. The area of the county is about 1,100 square miles, and the total mileage of roads about 1,400. In addition to the 400 miles of road already improved, many miles of earth roads are maintained in first class condition.

CONSTRUCTION

Warrenite, sheet asphalt, and bituminous concrete have been tried out satisfactorily. Where a concrete base has been laid, a thickness of 5 to 7 inches has been considered necessary, no reinforcing being used. The concrete mix has been 1:3:5 and 1:3:6. Integral curbs are constructed in connection with the concrete bases. A 2-inch crown is usually used. The thickness of the asphaltic wearing surface varies from 2 to 3 inches, depending upon the material and the type of base.

These roads have been built by contract. Their cost has varied with the changing conditions of construction during the past few years. The roads constructed with concrete base formerly cost about $40,000 per mile, but are now being built for about $30,000 to $35,000. The paved roads with stone base average about $20,000 per mile. All these roads have been built on a permanent basis of width and grade. A standard of 18 feet has been adopted for the width, and where possible all grades are limited to 5 per cent.

The same regulations as to grade and width apply, wherever possible, to the secondary roads. Many of these are not strictly secondary roads, but main roads that have not been paved. Chert, gravel and red ash are the surfacing materials. Gravel is used least of all; chert and ash interchangeably, according to which is handiest for the particular job.

The gravel is secured mainly from branches or small streams. Chert is secured from pits or banks. It is a flint-like rock that has decomposed or separated, so that it is found in about the same variety of sizes as bank gravel. It compacts well into a road, and wears well. It occasionally must be loosened with powder in the pit, but usually is easy to handle and spread. Pits are usually rented from the owner of the property at a rate of 5 cents to 8 cents per load of chert removed.

Ash costs nothing. It is the product of combustion in the waste piles of the coal mines of the county. The slate, muck, and other wastes of mining are stored in huge heaps near the mines as the easiest means of disposal. These heaps eventually catch fire, the result of the burning being a red ash which weighs about 1,600 pounds to the cubic yard, and which posseses sufficient cementing power to

A ROAD CONSTRUCTED BY PRISONERS IN JEFFERSON COUNTY.

*Road Superintendent of Jefferson County, Ala.

make a fine road material. In fact, it has some advantages that chert does not have, wearing smoother and evener, not washing so badly, and not raveling. So far as is known, this is the only place where this red ash is used for road work, though it must be available in all soft coal regions.

These secondary roads are sometimes built by contract, but usually by county forces. When the latter method is followed, the grading, especially if this is heavy, is done by contract. Plans for the future call for a grading gang, but practically none of this work is done at present.

In constructing these roads, the bed is shaped and crowned by machine, and 6 to 8 inches of red ash or chert applied to the surface. The ash or chert is hauled by motor trucks from the nearest pit or mine mouth, and dumped on the road. A scraper is used for spreading this material, and this is accomplished without leaving any hard-packed spots to turn into bumps later on. Rolling is generally not believed to be necessary and this department has found that roads compact very well under traffic, if scraped and reshaped once or twice during the packing process.

For an average road, about 2,000 cubic yards of chert or ash is required per mile. The cost of such a road, exclusive of grading, averages from about $1,000 per mile for the most favorable conditions of construction and haul, to $3,000 under the most unfavorable conditions.

The life of these roads varies from one to three years, depending mostly upon the amount and weight of traffic. They will not, of course, stand up for long under heavy trucks, especially during the wet season. Under average traffic conditions, the life exceeds two years, and a reshaping and scraping is necessary every two to three months or thereabouts, to keep them in first class condition.

MAINTENANCE

Road construction, after all, is a comparatively simple matter, and, in many ways, not so important as maintenance. It has been on maintenance that this branch of the county road forces has concentrated its greatest efforts, realizing that no matter what the original cost of the road, maintenance is necessary, and that without maintenance, the money spent on roads is almost a total loss. The object has been to keep every main road and every well-used secondary road in good condition for traffic, irrespective of weather or seasonal conditions.

The organization necessary for such a task, is, of course, a large one, and the work of keeping in shape nearly a thousand miles of road is costly. Added to this is the new construction work, which is carried on by the same forces.

CELL AT CAMP NO. 4

The personnel for doing this work consists of about 250 convicts, with enough foremen, guards, and skilled labor to make an efficient and smooth running organization. The free labor is employed in the operation of motor trucks, and in similar work requiring skill, intelligence and responsibility. These men are concentrated in seven camps located at strategic points throughout the county. To each camp is assigned responsibility for the condition of the roads in its district. The area assigned to these camps varies with the amount of road, its condition, and the number of men assigned to the camp, but generally varies from 150 to 250 square miles.

The personnel at the camps also varies, ranging from 20 to 100 men. The strictly road camps range from 20 men for the smallest to about 60 men for the largest. No. 2 camp is located at the county farm. Here are kept the prisoners unfit for the heavy work on the roads. They are employed, where capable of any work at all, on laundry, gardening and similar light work. It is the plan of the department to raise enough material on the county farm to materially reduce the living costs at the various camps. At No. 2 camp is also located the garage and shop for the repair of the county road equipment.

No. 1 camp is one of the smaller camps located about ten miles out of the city. About 25 men are maintained at this camp and the road working equipment includes 2 motor trucks, 20 mules, 10 wagons and 3 road machines. This camp is responsible for road construction and maintenance over an area of about 150 square miles.

No. 2 camp, as already stated, is at the county farm. In addition to the work already mentioned, the camp does considerable road work. The equipment includes 7 trucks, 2 combined tractors and road machines, and other smaller equipment. About 100 prisoners are kept at the farm and the camp.

No. 3 camp is located at Trussville. It is the only white camp operated by the department. About 60 men are kept at this camp, making it the largest of the strictly road camps. Three motor trucks, 20 mules, 10 wagons and 1 combined tractor and road machine are in use by this camp.

No. 4 camp carries from 30 to 40 colored prisoners and the equipment includes 6 motor trucks, 14 mules, 7 wagons, and 4 combined tractors and road machines. This camp maintains about 260 square miles, with about 300 miles of roads.

No. 5 camp is at Rosedale, southwest of and just outside the city limits. About 40 men are worked. The equipment includes 6 motor trucks, 20 mules, 10 wagons and 3 mule-drawn road machines.

No. 6 camp is located in the northern end of the county. There are 33 men, 20 mules, 10 wagons, 1 truck, and 3 road machines, one tractor drawn.

No. 7 camp is just being located in the south end of the county, at McCalla. It will have about 20 men, 1 motor truck, 16 mules, 8 wagons, a combined tractor and road machine and one mule-drawn road machine.

These camps are under the direct supervision of the road superintendent, who has charge of the construction and maintenance of all roads, excepting those constructed under contract.

(To be continued)

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CONTENTS

Plans for Water Works and Sewers

Last week we published the fourth of a series of articles dealing with the requirements of the several states that apply to the preparation by engineers of plans for water supply and sewerage. The first two gave abstracts of the state laws requiring that engineers be licensed in the state in question before practicing in it. The third and fourth stated, for each state, the conditions under which such plans must be submitted to the state health boards.

These will be followed, beginning next week, with brief synopses of the regulations of the several state boards specifying the kinds of maps, plans and reports that must be submitted. There has been some delay in the appearance of these articles because replies from some of the states have been coming in slowly, but we hope to complete the two or three instalments in which these data are to be presented in seccessive issues following the next one.

In examining the conditions under which plans must be submitted, we find that in some states there are no requirements whatever. These include Colorado, Delaware, Florida, Indiana, Michigan, Rhode Island, and South Dakota; although in some of these it was expected that such a law would be passed soon. In others, the state board, through personal influence and persuasion, have got the cities to ask its approval of such plans before they are constructed.

Alabama and Virginia, while requiring the approval of plans for water supply, have no such requirements concerning sewerage plans.

There are eight states from whose health boards or health officials we have not received replies to our inquiries, and we are of the opinion that in most if not all of these there are no requirements of this nature. If any of our readers can furnish us with information concerning the laws as to such requirements in these omitted states we will greatly appreciate receiving such information.

Most of the state laws authorize the state health boards to make and enforce regulations governing the preparing and submitting of plans and reports, and these regulations will form the subject matter of the articles that are to follow.

Imhoff Tank Discussions

Another series of articles that are of interest, and we believe of value, to all engineers engaged in sewerage work, is that in which discussions of the Imhoff tank are presented. These began with four instalments in January and February of an article by Russell Riker describing experiences with thirty-seven Imhoff tanks in New Jersey. In succeeding issues appeared discussions of this article by Waldo S. Coulter, J. G. Skeels, George T. Hammond, Paul Hansen, M. B. Tark, and Geo. L. Robinson; and in the April 22nd issue was a description of a patent taken out by Dr. Imhoff covering a process of mixing fresh sewage or sludge with Imhoff or other sludge.

This week we are presenting a discussion of the subject that contains some ideas obtained by a close observer during several years of operating such tanks; and we have others in hand and promised. Altogether, we consider Mr. Riker's article and these discussions as forming a most valuable contribution to the subject.

None of the writers seem to claim that the Imhoff tank has no faults, but several ask, or imply: "Is there any tank, however, which has less?" There is apparent agreement that the results with the Imhoff tank are somewhat better than with the septic tank when both are on their good behavior, but that the former can give an operator more kinds of trouble than the latter and with less apparent or discovered cause. At least one operator who has had charge of both kinds for years has told us that if he could he would abandon the Imhoff and go back to the septic.

One interesting and significant development is the patent recently issued to Dr. Imhoff wherein he provides for improving the operation of the tanks, including the Imhoff tank, by mixing fresh sewage or fresh sludge with the partly digested sludge. This naturally suggests the English hydrolytic or Travis tank which preceded the Imhoff tank in point of time but seems to have received little attention in England and practically none in this country.

The difficulty with the Imhoff tank most often referred to is the foaming, but Mr. Downes in this issue names a number of other less spectacular and glaringly evident, but which are important factors in successful operation of the tank.

As to foaming, there are all sorts of opinions as to both the cause and the remedy. Some have had

apparent success with one treatment, some with another, and both have proved failures in other plants. Some, having tried all the remedies of which they have learned and without any mitigations of the trouble, have reached the pessimistic conclusion that the only thing to do when a tank begins to foam is to let it foam until it is ready to stop, meantime doing as much as possible by hand labor to keep the foam from polluting the effluent.

It is admissible to think that there is no law governing the operation of an Imhoff tank, although the law may vary with variations in the tank design and especially in the character of the sewage. We certainly should not admit that it is beyond the skill of chemists, biologists and engineers to discover the cause. And we believe that it will be discovered; unless in the meantime a more satisfactory substitute is brought forward.

Principles of Contractural Relations

A joint committee was formed some time ago by the combination of committees appointed by the Boston Society of Civil Engineers and the New England Water Works Association, to report upon the eight important principles of contractural relations prepared as a part of the national movement inaugurated by Secretary Hoover. This joint committee has submitted its report, which is given below, somewhat abbreviated.

At the conference called by Secretary Hoover, attended by representatives of nine national engineering and contracting societies, some progress was made toward a standardization of construction contracts, with the aim of ultimately securing

"1. Less expenditure for legal services in drawing proper contracts, and the elimination of disputes over contracts already drawn.

2. Less duplication of work in the professions attendant on construction.

3. Better safeguard for owners and increased public confidence, and

4. An improved standard of construction service throughout the country."

The eight principles were published by the Associated General Contractors as follows:

1. The award of contracts on a basis of skill, integrity and responsibility, with the policy where practicable of eliminating irresponsible or inappropriate bidders before their proposals are received.

2. A satisfactory arbitration clause to be legally binding upon both parties.

3. A definite policy of inspection, with provision that if two or more separate interests are concerned in payment one authority shall act for all.

4. Specification of either the results to be obtained or the method to be followed, but not both.

5. Acceptance of work within a definite period after fulfilment of the contract, and as short a period of maintenance as is practicable.

6. Removal of responsibility from the contractor for contingencies beyond his control.

7. Reasonable limit upon the amount to which work under the contract can be increased or decreased.

8. Definite time and method of payment with provision for materials delivered.

"A study of the eight principles above outlined can only be made on a basis of broad interpretation. In public work, political conditions, existing statutes and other factors make it impracticable to follow out some of these principles.

"Therefore, in interpreting the principles which are endorsed by this committee in the following paragraphs, it should be borne in mind that the intention is that they are to be considered only on a broad basis, for adoption where conditions permit; that they cannot be taken literally in all cases; and that every construction contract cannot be written to include all of the principles. Furthermore, there are other principles of equal importance which should be incorporated in the same way, and which should be given due weight in writing a contract for construction work. The time available to this committee for its work has not permitted a consideration of these other important factors, except indirectly as they may have had a bearing on the principles hereinafter stated.

"With the general qualifications hereinbefore given, this committee endorses the following principles of contractual relations:

1. That proposals be invited only from responsible bidders; and that contracts be awarded with due regard to skill, integrity and experience.

2. (The conditions appertaining to different classes of work vary to such an extent that the committee does not feel prepared to endorse the principle of arbitration for universal application, although recognizing its desirability in many cases.)

3. That if two or more separate interests are concerned, one authority shall act for all,

4. That as a matter of general principle, either the results to be obtained or the methods to be followed shall be specified, but not both where they would conflict.

5. That work be accepted within a definite period after the fulfilment of the contract; and that as short a period of maintenance be required, as is practicable.

6. That the contractor be relieved of certain responsibilities for specified contingencies beyond his control,

7. That where the character of the work will permit there should be a stated limit upon the amount to which work under the contract can be increased or decreased, due to a change in plan,

8. That there be a definite time for, and method of, payment; and that where practicable and advantageous there be provision for payment for certain specified materials delivered, for the safekeeping of which the contractor shall be responsible."

"We believe that it is possible to prepare a standard form of contract, including only such general clauses as would be applicable to all construction contracts, or perhaps to certain classes of construction contracts, so that the general procedure covered by such clauses will be standardized, to the great benefit of all parties concerned in construction work."

A 12-mile section of highway near Champaign, Ill., will be tested by the State University, to determine efficiency and cost of oils and methods of application and time that oiled road is in good condition.

North Avenue Viaduct, Milwaukee*

Shoring, forms and arch centers used by the contractor, together with equipment.

SHORING AND FORMS

The arch ribs were supported on 3x10-inch lagging surfaced on all four sides. Lagging, 6x1-inch was used for the construction of most of the forms, for which there was required in all about 1,500,000 feet board measure of lumber. The shoring consisted principally of 2x4, 2x6 and 2x8-inch boards with 6x6-inch posts and some 2x12 and 3x10-inch planks. The shoring on which the viaduct forms were supported was completely detailed in the contractor's office and was erected like steel bridge falsework, in accordance with a plan and diagram. It was taken down and re-erected over and over again and eventually cut up for forms and other purposes after having served all the requirements for the shoring. The forms were made in comparatively large panels, all of them built in the shop to exact detailed drawings, thus reducing the field work and minimizing mistakes and delays.

All of the large forms were braced by interior horizontal wire ties that were very quickly and efficiently tightened by special outside steel angle clips, which were set and locked with a single motion and requiring no tools besides a hammer and a small bar. The clips were made of a 4-inch length of standard 2x2-inch angle with a center hole and two end slots in one flange. The other flange was set horizontal, with the vertical flange in contact with the outside of the form and the projecting ends of two wire ties were bent 90 degrees and inserted in the slots. The angles were then quickly revolved about 140 degrees until the edges of both flanges took bearing against the vertical side of the form and the wires, which were securely jammed in the slots, were thoroughly stretched and locked in position. This device, which was invented by L. J. Klug, was found more expeditious and satisfactory than any other method of fastening and tightening the wires and has been made the subject of a patent application.

ARCH CENTERS

Each of the arch ribs was supported during construction on three steel arch trusses, designed and fabricated by the contractor. The three trusses for each rib were braced together in pairs, each connected by horizontal and diagonal members. The trussed members were made entirely of pairs and double pairs of angles up to 6x6 inches, riveted together, back to back, with gusset plate connections. For each truss the top chord was shop riveted in sections with part of the web members attached. The remainder of the members and the bottom chords were shipped in separate pieces and all were assembled and the field splices bolted at the site and the trusses erected as units on falsework provided for the purpose. The total weight of all the trusses with their bracing was about 130 tons.

The arch trusses were not supported at their extremities, but had bearing on the flanges of the lower chord angles 7 feet on centers from the arch soffit at spring line. These bearings were seated 5 feet, 4 inches apart on a sill transverse to the bridge axis and composed of three 12-inch I-beams bolted together with separators. Under each truss the sill was supported with two sets of three wooden wedges in each set, making a total of six sets providing adjustment and elevating the sill a maximum of 15 inches above a lower sill consisting of five 12-inch I-beams riveted together with separators, under each of the two upper sills. Jackscrews set on the top flanges of the lower sill were placed in pairs on both sides of the trusses, four pairs in all for each end of each span, and served to raise and lower the trusses, adjusting them to the required elevation after which the wedges were driven to follow up and take the load. The wedges were made from 6x12-inch and 12x12-inch oak timber, tapered 2 inches in 3 feet. After the arch ribs had been poured and had set 30 days the jackscrews were replaced between the sills, the wedges driven out, the three trusses lowered onto rollers and moved over into position for the other arch ribs.

For each span the lower sills rested on eight lines of riveted steel stringers supported at the piers on the caps of a double bent of timber falsework, having altogether sixteen 12x12-inch vertical posts braced together with transverse and diagonal struts and seated on the extended concrete footings of the piers and abutments, to which the vertical posts were braced by horizontal struts bolted to the vertical concrete webs.

CONTRACTOR'S EQUIPMENT

Besides the items already mentioned, the principal plant installed by the contractor included another stiff-leg derrick with 75-foot boom, located at the east end of the bridge, one Mundy and one Lambert two-drum hoisting engine, one 220-foot Insley steel hoisting tower, one single drum Lidgerwood hoisting engine, one 150 horsepower Scotch marine boiler installed at the mixer plant and supplying steam for the adjacent hoisting engines, one C. H. & E. hoisting engine in the yard, one Browning revolving steam shovel mounted on caterpillar traction and equipped with a ½-yard clamshell bucket and auxiliary 40-foot boom, and one electrically driven combination punch and shears used for fabricating the steel arch trusses.

There was a carpenter shop supplied with a circular saw, two combination saws, one 36-inch band saw, and a 24-inch jointer, all driven by electricity. There was also an oxy-acetylene torch used almost constantly for all sorts of cutting and repair work, including the brazing of the cylinder heads.

The maximum force employed was about 300 men, and the average about 100 men. No labor troubles were experienced. The viaduct was opened to street car and pedestrian traffic December 4, 1921, and to vehicle traffic December 15, 1921, the short delay being due to the paving of the roadway which was done under a separate contract.

The bridge was designed and built under the direction of the department of public works of the city

*Continued from page 280.

of Milwaukee, Percy Braman, Commissioner of Public Works and David McKeith and M. C. Cutler, Superintendents of Bridges and Buildings. The contractor was the Klug & Smith Co., Milwaukee. W. O. Krahn and George R. Young were respectively superintendent and field engineer.

Imhoff Tank Results

By John R. Downes*

The claims made for the Imhoff tank and the extent to which they are justified by results obtained are discussed by one of the leading sewage plant operators of the country.

One of the most experienced, thorough and successful operators of sewage treatment plants in the country is the superintendent of the plant serving Plainfield, North Plainfield and Dunellen, New Jersey. His discussion of the subject introduced by Mr. Riker's articles in PUBLIC WORKS, which he has kindly written at our request, is a most valuable contribution to the literature of the subject.

In commenting on the articles by Mr. Riker and others which have recently appeared in PUBLIC WORKS, my first duty is to say that Mr. Riker has done a real service in setting forth the present status of the Imhoff tank; if, indeed, the present conditions can be said to constitute a status.

Mr. Paul Hansen's attitude is typical of that of nearly every consulting engineer with whom I have come in contact: i. e., "if we condemn the Imhoff tank, what have we to take its place?"

In order to decide whether or not one can succeed "in making a case against the Imhoff tank," we should compare the claims made for the tank with the results obtained by its operation. The question is, do we consistently get a better effluent from Imhoff tanks than from other available types of sedimentation tanks; and, if we do, is the result obtained at a reasonable cost for construction and operation?

My personal experience of four years with septic tanks and five years with Imhoff tanks on the same sewage would indicate that we do not get value for our money.

The following is an outline of the claims made for the Imhoff tank:

(1) That the solids would be separated from the liquid by sedimentation exactly as they are in septic tanks or "plain settling tanks."

(2) That the solids, once settled out, would be deterred by the sloping baffles and gas traps from again contaminating the flowing sewage—that the result would be a consistency better effluent than could be obtained from septic tanks.

(3) That the removal of the settled solids from the settling tank to the digestion tank could be accomplished at less expense than the removal of solids from a plain settling tank to a disconnected tank for further treatment.

(4) That the removal of solids from the digestion tank could be accomplished at little cost and without nuisance.

(5) That the operation of the Imhoff tank would be free from the objectionable odors more or less generally associated with septic tanks.

(6) Continuity of service, making possible the use of fewer units, would lead to economy of construction. As would, also, the construction of the settling tank within the digestion tank.

Results obtained:

(1) On claim one, the tanks make good. The Imhoff tank clarifies the sewage by sedimentation the same as any other settling tank which has been designed with due regard for resulting velocity of flow.

(2) Has not been established in practice in the majority of Imhoff tank installations. The effluent of the settling tank is all too frequently fouled and made more or less septic and odoriferous by the presence of partly digested solids returned from the digestion tank by way of one of four sources. These sources I classify, arbitrarily, as follows: (A) gray foam, (B) black foam, (C) film, (D) brown gelatinous flock.

(A) Gray foam is the typical yellow-gray froth, usually acid in reaction, and of a nauseating, sour odor.

(B) Black foam pours over the tops of the gas vents as does the gray foam but much less violently, it is alkaline and has usually only a musty odor.

(C) Film is a black inky liquid that almost always exists at some point in the digestion tank between the scum and the sludge. When it reaches the vicinity of the slots, it is bound to pass through into the settling tank by diffusion and by way of thermal currents. I call this inky liquid "film" because of the rapidity with which it forms a film upon the surface of the settling tank. It is highly charged with hydrogen sulphide, the odor of which it imparts to the tank effluent and it causes an unwarranted oxygen drain on subsequent oxidizing devices. This "film" must be recognized as getting into the settling tank in the form of any inky liquid, as distinguished from masses of black solids which sometimes rise in patches and at once suggest dirty slopes or slots.

(D) The brown, gelatinous flock, I take to be the same thing as the black "film," except that it has not reached the same stage of digestion. It has something the appearance of an iron hydroxide flock, but is much lighter. Like the black, inky liquid it is a vagrant, drifting somewhere between the sludge and the scum of the digestion tank.

Evidently Imhoff predicated his combination of the settling and digesting tanks with slot connection on the theory that there would be a clear line of demarcation between sludge and supernatent liquid. Operating experience shows that we do not get such clear division and the persistent presence of the two conditions outlined above (as also of a viscous yellow liquid which seems to precede their production) suggest that some other than a slot connection between settling tank and digestion tank is necessary.

So much attention has been focused on the "foaming" of tanks, that one is apt to get the idea

*Superintendent Plainfield Joint Sewage Disposal Plant.

that a tank which is not foaming is working satisfactorily. Foaming is an intermittent difficulty, the above conditions are persistent sources of trouble.

(3) Claim three, the inexpensive transfer of settled solids from the settling tank to the digestion tank of the Imhoff combination, is an established fact. Later developments of cone bottom tanks and air displacement sludge ejectors seem to open the way to a connection more satisfactory than a slot between the settling and digesting tanks.

(4) Claim four, the removal of solids from the bottom of the digestion tank of the Imhoff combination, is certainly accomplished at little cost. Odor from the sludge is less than that from septic tank sludge because we are able to draw ripe sludge without the inclusion of that which is still decomposing. The odor caused by the exposure of well-ripened sludge on drying beds must be recognized, but is one of the minor sources of trouble.

(5) Personal experience would indicate that as between Imhoff tanks and septic tanks treating the same sewage there is little choice as to odor. Considering only the quality of the effluent and cost of operation, I think that Mr. Riker's suggestion for a multiplicity of septic tanks to be operated in rotation would be preferable to Imhoff tanks. We must face the fact, however, that in time we will have to collect and control the gases evolved in the digestion process. Collection of gases could be better provided for in a comparatively deep digestion tank with correspondingly small surface area. The same consideration would lead to the adoption of the chimney type of gas vent in preference to the longitudinal vent on the digestion tank wherever one felt justified in installing the Imhoff combination. The work of gas control, recently reported by C. E. Leonard, city engineer of Austin, Texas, is a great advance in the art of sewage disposal. (Engineering News-Record, April 6, 1922.)

(6) Claim 6, continuity of service, is not achieved by the Imhoff combination. It is constantly necessary to cut out tanks, the effluents of which have become fouled by the conditions described under claim (2). If a plant is liberally designed, we might possibly depend upon keeping two-thirds of it in condition for operation. The building of the settling tank within the digestion tank seems a good deal like trying to make two things occupy the same space at the same time. It seems that the expense of building an entirely separate settling tank would be justified by the number of difficulties which it would eliminate. This is specially true as a number of engineers have even overdesigned the settling tanks in order to provide space for the digestion tank beneath it, where deep construction of the digesting tank was to be avoided.

Throughout this discussion I have used the terms settling "tank" and digesting "tank" in preference to the term "compartment" because I wish to emphasize the fact that they are two separate things combined simply for the purpose of transferring solids from one to the other.

Dr. Travis aimed at separate digestion of the solids after removal from the liquid, but was handicapped by the belief that an admixture of fresh sewage was necessary to sclid digestion. Imhoff thought this belief a fallacy and made the separation more complete, but retained the easy method of transferring the solids from tank to tank. Both overlooked presence of the vagrant film-producing liquid which torms in the vicinity of the slots; hence a step forward that is in order is the recognition of the presence of this trouble maker. It seems logical to prevent this return action by shutting the gate instead of leaving the slot open.

Having in this way assured ourselves of a fresh, well clarified effluent, which is our aim, if there is any difficulty in digesting the sludge, that is another problem to which we should apply ourselves at once. I believe that investigation will prove this oft-mentioned difficulty to be a mere bugaboo.

Automobile Camps in Florida

At least thirty-eight established auto camps in the state, of which a survey was made by the State Board of Health, and sanitary control of them was urged.

Probably few if any of the eastern states are visited by a larger number of camping automobilists than is Florida, and it certainly is to be questioned whether any of the states pay more attention to the sites used by the auto tourists for camping purposes. In a paper recently read by George W. Simons, Jr., the chief sanitary engineer of Florida, he stated that a conservative estimate of the number of auto tourists in Florida last winter was 10,000, a considerable percentage of which spent more or less of their time in tourist camps. At the end of 1921 there were at least 38 established auto camps in that state, 30 of which were maintained by the municipalities and the remainder by private individuals. All of these were located conveniently along heavily traveled highways in so-called tourist centers.

Realizing the importance of the sanitary conditions surrounding these camps to the health not only of the tourists themselves but also of the residents of the country in which they were spending several days or weeks, the state board of health urged all communities that were visited by tourists to use the greatest diligence and attention in maintaining sanitary conditions at the camps. A survey was made of the camps in the state, particular consideration being given to what Mr. Simons considered the six fundamental requirements, namely: (1) Is the camp established in accordance with the provision of a city ordinance and is such ordinance being fully observed by camps? (2) Who superintends the camp and how efficiently is it supervised? (3) What is the source of the camp's water supply and where is it located? (4) What disposition is made of human wastes—by city sewerage, septic tanks, or privies? (5) What disposition is made of rubbish, garbage, etc., and what is the frequency of removal? (6) Are refuse containers provided and what number?

It was found that 15 of the 38 camps were regulated by local ordinances conforming to the regula-

tions of the state board of health. Three of these ordinances had been adopted prior to 1921 and the remainder during the latter half of that year. Last October West Palm Beach established and equipped a camp in charge of a paid superintendent and adopted ordinances which were so complete and admirable that copies were sent by the state board of health to the other cities of the state to be used as a model.

Seven of the municipal camps are in charge of paid superintendents or special officials designated to care for such places. Seventeen camps are supervised solely by marshals or town police. Mr. Simons believed that camps having more than 20 campers continuously should be in charge of a special designated official, while those having few campers may not warrant a full-time inspector. The private camps operated for profit are generally in charge of paid superintendents who maintain good sanitary conditions.

A prime essential of every camp should be a plentiful supply of pure drinking water. Most of the cities where camps are located have recognized this and where possible have piped city water to the camps, or have driven wells where city water was not accessible.

Of the 38 camps, 21 are provided with flush toilets connected with the city sewers or to septic tanks of approved design.

The trash and refuse should be collected from camps, at least once a day where the camp is large, although fewer collections may be required for the smaller camps. There should be at every camp a number of metal, tightly covered garbage cans. The medium size camps usually provide from 6 to 10 cans, or one for every 5 to 7 automobilists, and no camp should provide less than 2.

Highway Work Done During 1921

Tabulation of data for several hundred counties in the various states, giving total amount spent—county, State and Federal funds—and the amount of each kind of construction for which this money was used.

County and State	Money spent for highway work	Kinds and amounts of highway construction
Alabama		
Etowah	$69,529	5 mi. chert surf. & 2 mi. Tarvia surf. treatment
Montgomery	300,000	Gravel & conc. bridge work
Arkansas		
Crittenden	2,850,000	14 mi. conc. surf., 53 mi. gravel surf.
Hempstead	313,000	29 mi. gravel
Scott	20,000	Graded road work
California		
Fresno	1,250,000	60 mi. asph. conc.
Plumas	60,000	Maintenance only
Sacramento	400,000	6 mi. conc. at $15,000 per mi.—$110,000 for bridge
Solano	125,000	9.000 lin. ft. asph. conc. ($35,000)
Sutter	644,752	11.7 mi. rein. conc.; 23.2 mi. oil mac.
Yuba	205,000	10.2 mi. block base, warrenite top
Colorado		
Chaffee	.....	4 mi. gravel roadbed, bridges, etc.
Elbert	120,000	30 mi. dirt. surf., bridges & culverts
Lake	14,362	½ mi. loam rd. graveled
Lincoln	80,000	Sand & gravel surf. & natural dirt grade
Logan	269,797	3,900 lin. ft. conc.
Delaware		
New Castle	850,000	2 mi. W.B. mac. surf. treated., 3 mi. bit. mac., 4.2 mi. surf. w. bit. mac. conc., 5.2 mi. surf. w. conc. 2 mi.
Idaho		
Clark	6,500	Gravel surf.
Power	116,500	14.2 mi. gravel surf.
Shoshone	117,533	5½ mi. graded natural gravel surf.
Illinois		
Calhoun	140,000	Earth construction
Carroll	131,000	1 mi. gravel, 1 mi. mac., 10 mi. oiled earth
Christian	230,000	Oiled earth & earth
Clay	25,600	Earth grading, 10 or 12 mi. conc. slab.
De Witt	.....	Oil surf.
Fulton	210,000	Earth work & bridges
Hamilton	36.000	Earth work
Iroquois	220,000	6 mi. gravel, 9 mi. conc.
Johnson	50.000	Earth
Kane	730,000	13 mi. conc. (18 ft. P. C.)
Knox	300,000	Conc. roads
Lee	250,000	3 mi. stone rd., 12 mi. gravel
Logan	80,000	15 mi. gravel
Marion	.....	Earth
McDonough	185,000	Earth rds., 70 mi. grading work; maint.
Illinois (Continued)		
McHenry	221,000	1 mi. conc., 5 mi. grad. for conc. rd.
Monroe	60,000	4 mi. mac.
Pope	33,125	8 mi. gravel rd.
Pratt	20,000	Grading earth & deep fills
Pulaski	200,000	18 mi. earth rd. bed, 20 mi. gravel, 5 mi. mixed
Stephenson	250,000	Grad. & bridge work for hard surf. rd., $130,000
White	100,400	$56,000 gravel
Williamson	276,000	6 mi. conc., 7 mi. gravel
Winnebago	304,224	9.25 mi. conc.
Woodford	.....	Graded earth 56,320 ft.
Indiana		
Decatur	250,000	10 mi. mac., 5 mi. conc.
Dubois	100,000	10 mi. plain mac.
Hancock	300,000	13 mi. conc., 6 mi. stone, 30 mi. gravel
Henry	85,000	For bridges
Howard	175,000	3 mi. conc., 5 mi. stone, 7 mi. gravel
Jackson	50,000-75,000	¼ mi. rein. conc., 4 mi. screened gravel
Jasper	500,000	20 mi. gravel, 50 mi. crushed stone
Jennings	73,000	4 mi. gravel, 6 mi. mac.
Johnson	469,000	10 mi. 1-course conc., $284,000; 15.49 mi. grav., $175,000
Madison	656,000	180,000 sq. yds. cem. conc., 8½ mi. grav.-crushed stone
Morgan	265,000	25 mi. gravel, 10 mi. stone, gravel & crushed stone
Posey	.....	Gravel only
Shelby	328,557	½ mi. conc., 12 mi. stone & 25¾ mi. gravel
St. Joseph	1,198,406	21.35 mi. conc., 6.14 mi. asph. penetration, 11.2 mi. gravel
Vermillion	140,000	2½ mi. conc., 3 mi. gravel, 3 conc.
Vigo	2,500,000	14 mi. conc., 5 mi. asph., 5 mi. brick, 35 mi. gravel
Wayne	280,000	50,000 sq. yds. conc. pavt.
Iowa		
Adair	185,000	Earth
Allamahee	122,694	$60,000 earth rd. to permanent grade
Benton	690,000	9 mi. 18-ft. conc.
Blue Hawk	112,000	2 mi. grav. surf., & some grad. & drain.
Boone	390,000	25 mil. gravel
Bremer	130,000	$100,000 earth
Buena Vista	90,000	10 mi. gravel
Cass	180,000	Bridges incl. in this amt.
Cerro Gordo	710,000	13 mi. conc. 18 ft. wide, 8 mi. gravel
Chickasaw	124,000	$89,000 bridge, 16 mi. gravel surf.

Highway Work Done During 1921—Continued

County and State	Money spent for highway work	Kinds and amounts of highway construction
Iowa (Continued)		
Clarke	190,000	$35,000 earth rd.
Clay	67,740	53 mi. gravel surf.
Clinton	1,160,000	17.2 mi. conc.
Crawford	75,000	Earth
Dallas	380,000	85 mi. gravel surf.
Davis	287,000	Dirt
Decatur	20,000	Earth
Dickinson	250,000	52,800 sq. yd. conc.
Dubuque	200,000	None
Floyd	321,702	5.6 mi. conc., 8.88 mi. graveled, 6.67 mi. graded
Guthrie	330,000	12½ mi. earth
Hamil	200,000	5 mi. gravel surf.
Hancock	350,000	10 mi. conc., 4 mi. grad. & gravel. surf.
Harrison	55,000	$15,000 earth rd. to perm. grade
Jackson	150,000	16 mi. earth const., 150 maintained
Jasper	180,000	14½ mi. gravel rd., $54,400
Kossuth	400,000	Earth surf., $300,000
Linn	250,000	6½ mi. conc., 40 mi. earth
Lyon	225,000	$110,000 perm. grade, $40,000 gravel surf.
Marshall	420,000	5.93 mi. 18' rein. conc., 4¾ mi. gravel
Mitchell	250,000	27 mi. drain., grad. & gravel
Monona	173,822	All for bridges & grad.
Monroe	90,000	Earth
Montgomery	125,000	Dirt roads
Muscatine	320,137	All grad. work, culverts & bridges
Palo Alto	580,000	9 mi. conc., 30 mi. grav. surf.
Pocahontas	538,935	43 mi. gravel surf.
Pottawattamie	129,636	$60,000 earth
Ringgold	100,000	Earth rds. to perm. grade
Sac	315,000	43 mi. gravel
Scott	1,392,862	15 mi. brick, 3 mi. mac.
Shelby	135,234	None
Stony	400,000	25 mi. gravel
Union	316,000	15.5 mi. perm. grade & bridges
Wapello	175,325	Dirt $39,182.67
Warren	235,300	No Surf.
Webster	400,000	24 mi. gravel
Worth	90,000	9 mi. graded, now being graveled
Kansas		
Anderson	400,000	7½ mi. gravel.; excav. & culverts on 8½ mi.
Barton	264,865	3 mi. conc., 150 mi. temp. grade
Bourbon	400,000	21 mi. bitum. mac.
Butler	250,000	None
Clay	27,800	Dirt rds. only
Closed	132,000	No. surf.
Doniphan	268,056	5 mi. conc. rd.
Finney	985,000	20 mi. conc. 16-ft. slab
Geary	292,075	7.8 mi. conc. (2-course), 1 m. (1-course), .716 mi. brick
Greeley	7,000	16 mi. earth
Harvey	90,863	Sanding 5 mi., $6,050
Jackson	68,060	92.75 mi. graded
Kearny	13,169	None
Mitchell	420,422	10 mi. conc., 70 mi. earth grading
Montgomery	550,000	24 mi. gravel rd.
Neosho	97,278	50 mi. dirt, 1½ gravel
Pawnee	38,477	3 mi. sand-clay, $8,575.50
Republic	174,000	None
Sheridan	40,000	Dirt rds. only
Sumner	419,395	Conc., $209,144; earth, $80,238.
Wabaunsee	93,180	$30,662 dirt work
Wichita	6,000	Earth
Kentucky		
Allen	284,000	.7 mi. rock asph., 14 mi. grav. surf., 6 mi. grad.
Boyle	62,000	W. B. mac.
Daviess	150,000	6 mi. grav.; grad. earth rds.
Hancock	100,000	13 mi. grad. & drain
Henderson	202,310	15 mi. grad. & drain, 5 mi. gravel, 2½ grav. resurf.
Morgan	20,000	Grade work only
Owen	52,000	3 mi. W. B. mac., 3 mi. new location, heavy grad.
Rockcastle	187,000	3 mi. mac., 5 mi. grad., 4 mi. surf. treat., bridge
Shelby	136,000	Bitum. surf.
Trigg	340,000	Gravel
Whitley	160,000	W. B. mac. surf. treated
Louisiana		
Allen	160,000	22 mi. gravel rds.
Caldwell & La Salle	150,000	Sand-clay gravel 14 mi. in Caldwell & 16 under const.; 14 in La Salle
Maryland		
Kent	220,000	6 mi. 15 ft. wide conc.
Massachusetts		
Middlesex	.....	3,500 mi. public rd, all sorts surf.

County and State	Money spent for highway work	Kinds and amounts of highway construction
Michigan		
Alger	274,258	W. B. mac. $50,000, grad. & drain. $110,000
Branch	350,000	Gravel 9 ft. wide, 8 ft. depth
Eaton	354,380	1.385 mi. conc. base & bit. top, 42.205 mi. grav. surf.
Huron	485,976	6 mi. conc., 2 mi. Tarvia pen., 41 mi. gravel
Kalkaska	100,000	½ mi. conc., 6 mi. gravel
Luce	120,000	7 mi. W. B. mac.
Macomb	1,000,000	23.25 mi. gravel, 7.75 mi. slag-gravel, 9.83 mi. cem. con., 5.25 mi. asph. conc.
Mecosta	175,000	1 mi. conc., 10 mi. 16-ft. gravel, 12 mi. 9-ft. gravel
Oakland	1,866,743	15½ mi. conc., 34½ garvel, 15 asph., 1 brick
Ontonagon	175,000	6 mi. mac., 7 gravel, 19 sand clay
Minnesota		
Aitkin	270,000	27.33 mi. gravel
Blue Earth	300,000	60 mi. gravel, $140,000
Chippewa	194,119	25 mi. gravel surf.
Clay	184,062	15 mi. gravel, 15 earth
Cottonwood	114,000	14 mi. dirt, 4 gravel
Crow Wing	388,433	4.4 mi. conc., 20 clay-gravel surf.
Dakota	460,961	1 bit. hard surf., $54,222; 33.2 mi. graded & graveled rds., $321,945
Dodge	196,219	20½ mi. graded rd., 13 mi. graveled
Faribault	363,057	71 mi. gravel surf.
Goodhue	168,500	25 mi. gravel surf.
Grant	99,992	5 mi. earth, 15 gravel
Hubbard	265,000	41 mi. graded
Isanti	110,286	15 mi. gravel surf.
Jackson	160,000	77 mi. gravel surf.
Kandiyohi	500,000	14 mi. conc., 15 grad., 15 gravel
Lake	140,000	58.25 mi. gravel & earth rds.
Lincoln	70,993	6 mi. gravel
Lyon	269,582	40.2 mi. grad., 24 grav. surf.
Martin	261,470	7 mi. dirt, 22 mi. grav. surf.
Meeker	364,000	All gravel surf.
Murray	126,000	24 mi. gravel
Nobles	184,239	$63,712 gravel
Norman	96,000	None
Ottertail	300,000	30 mi. gravel, 15 mi. earth
Pope	60,000	8 mi. grad., 15 gravel
Redwood	137,000	$58,000 gravel
Rice	588,595	2 mi. conc., 53.73 gravel surf., 28.89 grade
Roseau	36,000	Gravel
Stearns	300,000	25 mi. gravel
Swift	152,090	7.4 mi. conc., 12 mi. gravel, 1 grad. & gravel
Todd	347,000	38 mi. gravel
Washington	144,000	10½ mi. grad. & gravel
Watonwan	316,000	$240,000 conc., $12,000 grav., $52,000 grad.
Mississippi		
Noxubee	77,000	$75,000 gravel, $2,000 sand-clay
Missouri		
Butler	150,000	16 mi. grad., bridge & culvt., 2½ gravel surg., ½ conc.
Clinton	80,000	Dirt only graded to 6%
Cooper	100,000	Conc., brick, asph. & tarvia
Harrison	150,000	Dirt grade
Jasper	570,000	16¾ mi. conc., 18 gravel
Linn	118,000	Dirt rd. & bridges
Mississippi	550,000	$500,000 conc. rds. & bridges, $50,000 garded earth
Montgomery	40,000	Gravel, crushed rk. & earth
Rolls	22,000	10 mi. gravel, 30 mi. earth
Stoddard	170,000	Gravel surf.
Washington	50,000	10 mi. gravel
Montana		
Custer	125,118	13.8 mil. grad. & gravel, 119 mi. graded dirt, steel & concrete culverts
Deer Lodge	51,649	None
Granite	43,227	8 mi. gravel, 3 earth, maint.
Nebraska		
Knox	75,000	10 mi. gravel, 25 earth
Musselshell	88,907	None
Prairie	39,302	44 mi. graded earth rd.
Richland	35,398	$21,566 new work, dirt rds. & bridges; $80.76 machinery & supervision
Sheridan	50,000	21 mi. earth
Toole	125,000	12 mi. grad. & gravel, 70 mil. grad. only
Valley	30,000	None
Nebraska		
Morrill	30,000	None
New York		
Salem	500,000	15 mi. conc., 10 mi. gravel
Sussex	442,000	1½ mi. conc., 16 mi. gravel
Union	575,000	.....

(To be continued)

NEWS OF THE SOCIETIES

CALENDAR

May 8-12—AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Atlanta, Georgia.

May 9-11—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. Atlantic City, N. J.

May 12—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting. Automobile Club of America, New York City.

May 15-19—AMERICAN WATER WORKS ASSOCIATION. 42d annual convention. Bellevue-Stratford Hotel, Philadelphia. Secretary, J. M. Diven, 153 W. 71st St., New York.

May 15-19—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention. Atlantic City, N. J.

May 16-18—CHAMBER OF COMMERCE OF U. S. A. 10th annual meeting. Washington, D. C.

May 22-25—STATE PARK SECOND NATIONAL CONFERENCE, Bear Mountain Inn, Palisades Interstate Park, N. Y. Secretary Edgar E. Harlan, Des Moines, Iowa.

June 4-6—AMERICAN ASSOCIATION OF ENGINEERS. 8th annual convention. Salt Lake City, Utah.

June 7—NORTHWEST SECTION, NATIONAL ELECTRIC LIGHT AND POWER ASSOCIATION. Boise, Ida.

June 13-16—CANADIAN GOOD ROADS ASSOCIATION. Annual convention. Victoria, B. C.

June 19-22—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Summer meeting. Clifton Hotel, Niagara Falls.

June 21-22—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Portsmouth, N. H.

June 26-30—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual convention. Niagara Falls, Ont.

June 26-July 1—AMERICAN SOCIETY FOR TESTING MATERIALS. 25th annual meeting. Chalfonte-Haddon Hall Hotel, Atlantic City, N. J.

Aug. 28-Sept. 2—NATIONAL SAFETY CONGRESS. Detroit, Mich.

Sept. 11-15—ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. New Auditorium, Cleveland, Ohio.

Sept. 25-28—SOUTHWEST WATER WORKS ASSOCIATION. Annual convention. Hot Springs, Ark.

Oct. 9-13—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Cleveland, Ohio.

Oct. 16-19—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. Cleveland, Ohio.

Nov. 15-16—NATIONAL INDUSTRIAL LEAGUE. Annual meeting. New York City. Secretary, J. H. Beek, Chicago.

AMERICAN WATER WORKS ASSOCIATION

Forty-second annual convention, Philadelphia, May 15-19, 1922.

Many papers have been put on the program especially for the benefit of the operating members. Look over the tentative program, a copy of which is mailed herewith, and select such papers as interest you or that are on subjects that you have had experience in and are thus qualified to discuss; prepare your discussion on all such papers and tell freely your own practice and experience for the benefit of fellow members. Especial attention is called to the Friday forenoon program, joint meeting with the chemists and bacteriologists to discuss water purification and chemical troubles.

Superintendents' program — Group meetings will be held on Monday, registration and committee meeting day, for the consideration of:

1. Office Methods, Records, Accounts, etc.
2. Pumping Station, Engines, Boilers, Firing, etc.
3. Filter Operation and Care.
4. Pipe Laying, Methods, Records, etc.
5. Services and Meters. Material of Services, Laying. Meter Setting, Reading and Care.
6. Water Sheds and Reservoirs, Their Care and Protection, Algae Treatment, Tree Planting.
7. Private Fire Protection Services. Especially inter-connection with polluted sources and the efficiency of double check valves on such services.

Papers scheduled for Superintendents' Day that are expected to be of interest to operating water works men, also, time is given for topical discussions, and the following subjects and questions have been suggested. Others are asked for.

Select the topic you are most interested in at the time, help form a group to talk it over, free from the restraints of the larger meetings. The Group Meetings are also intended to give the members a better chance to get acquainted.

If you are specially interested or have anything to tell on any of the Group Topics that will be a help to your fellow members please send word to the Secretary so that you can be assigned to the Group. Leaders of the discussions are needed for each Group and you are asked to volunteer.

(1) Methods of preventing tampering with water meters, use of devices, odd sized couplings for inlet and outlet, or others to prevent reversing a meter.

(2) Meter testing tanks, use of weight or volume in tests.

(3) Use of check valve on metered services and responsibility for blowing up of hot water boilers by reason of the installation of check valves. Legal decisions on this point are particularly wanted.

(4) Connections to high pressure fire systems for sprinkler or other private fire protection use.

(5) Underground electric conduits, their location in relation to water mains. Water from leaks carried by underground electric conduits.

(6) Experience with underwriters' double check valve on services to factories having a secondary fire supply from a polluted source.

(7) Removing lead joints from cast iron pipe, process and after use of removed lead.

(8) What proportion of scrap lead, ends of lead service pipe, old service pipes, lead from burned out joints, etc., can be used without injuring the lead for pipe joints.

(9) Extra strength joints, where especial care is needed, as under railroads. Use of tin or other alloys with the lead to strengthen the joint.

(10) Foundry prepared joints, economy in their use, are they as satisfactory and efficient as poured joints.

(11) Use of substitutes for lead in pipe joints.

(12) Use of modern cast iron service pipes of small size, for domestic services.

(13) Care of water sheds, fishing and boating permits on reservoirs and control of their use.

(14) Use of valves of less diameter than the mains.

(15) Fire hydrants, locating and spacing.

(16) Waste prevention for small plants. House to house inspection. Simple tests for main loss. Prohibitively high rates for wasteful plumbing appliances.

(17) Outfits for thawing fire hydrants, services and small water mains.

(18) Valves on main lines closing by reason of vibration, water hammer or other causes except breaking.

(19) Service pipes, who pays for them, and maintains after installation?

(20) Cleaning or sterilizing water pipes before laying or after laid and before put in service.

(21) Pollution from railroads running near or crossing supply streams or reservoirs.

(22) Oil saving devices for pumping stations, filtering, reusing, etc.

ENGINEERING TRAINING CONFERENCE

The Second Public Conference on Business Training of the Engineer and Engineering Training for Students of Business has been called by the U. S. Commission of Education on behalf of the Committee on Commercial Engineering, and is to be held at the Carnegie Institute of Technology in Pittsburgh, May 1st and 2d. Invitations to appoint delegates to this conference will be sent to engineering and scientific organizations, educational, commercial and trade associations.

VERMONT SOCIETY OF ENGINEERS

At the tenth annual meeting of the Vermont Society of Engineers, held in Burlington, March 10th, addresses were given by Judge S. R. Moulton on "The Development of Law in Relation to Engineering Problems" and by Allen Hazen on "Public Water Supply." The following officers were elected: President, James M. Morrison; vice-president, L. E. Dix; secretary, G. A. Reed, and treasurer, T. W. Dix.

New Appliances

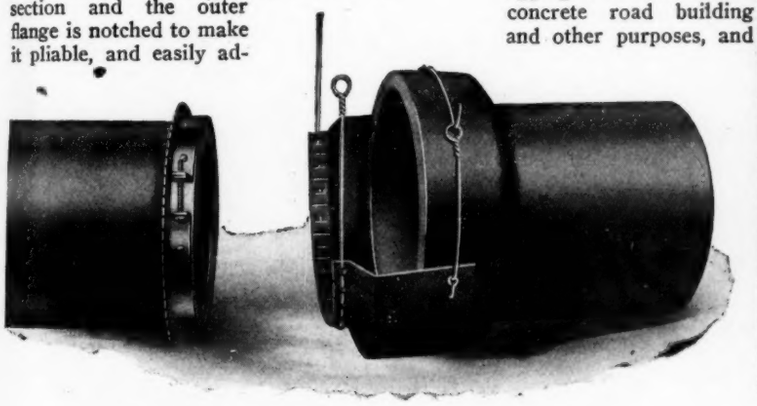
Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

WESTON PIPE GASKETS AND FORMS

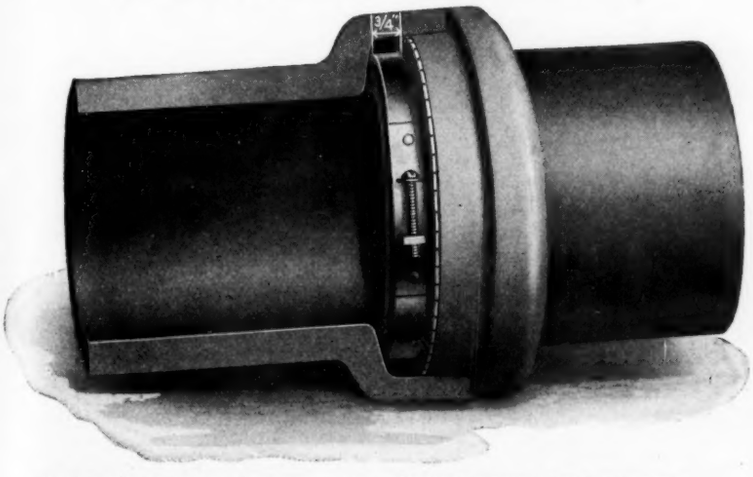
A flexible steel gasket and form that is quickly and easily applied to the hub and spigot joint of a tile drain or sewer pipe is manufactured and sold by L. A. Weston. The use of this gasket eliminates all other packing and insures the production of a tight joint and perfect alignment by common labor. With this gasket and form the proper pouring of cement can be quickly determined by inspection and the joints can be made in trenches containing water and with water running through the pipes, provided the depth of the water is not more than half the inside diameter of the pipe, thus sometimes avoiding an excessive amount of pumping or sub-drainage. The use of this device also permits partial backfilling of the trench before the joints are made, thus promoting proper alignment of the pipe and preventing the breakage of the joints during backfill. It also precludes the penetration of roots into the sewer.

The flexible form has an L-shape cross section and the outer flange is notched to make it pliable, and easily adjusted to the pipe. The gasket centers the pipe and takes up only ¾ inch in the depth of the socket, leaving the remainder of the space for the cement point. The gasket forms a full circle and is held in position by an adjustment bolt passing through radial flanges.

The form, which somewhat resembles the gasket reversed, also has a radial flange notched to give it flexibility. It is semi-cylindrical and is set on the lower side of the pipe and held in position by circumferential wires twisted tight. It is filled solid with thin cement mortar or grout and after this is set the top of the joint is trowelled.



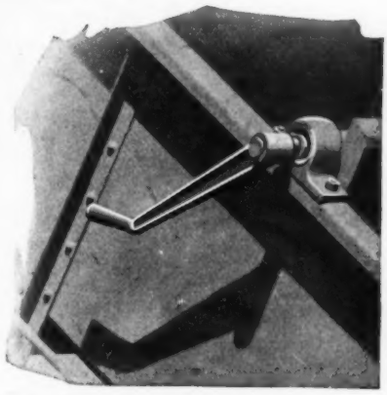
WESTON'S FORM FOR TILE PIPE CEMENT JOINTS.



CEMENT JOINT MADE WITH WESTON'S FORM AND GASKET.

HEIL SWINGING TRUCK PARTITIONS

The Heil Co.'s swinging partitions to subdivide truck dump bodies, separate their loads and permitting portions of them to be dumped independently and successively are extensively used for handling aggregate in batches for concrete road building and other purposes, and are claimed to be the most simple type on the market.

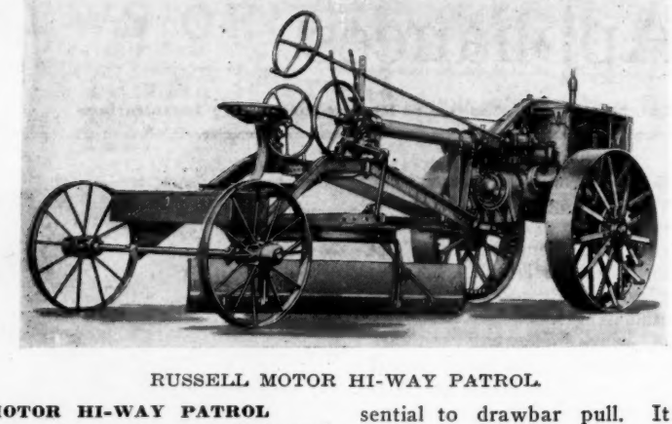


HEIL PARTITION CRANK.

HEIL PARTITION FOR DUMP TRUCK BODY.

Any number of partitions can be installed on any dump body, requiring only to bolt the bearings to the top of the body with a couple of small bolts at each bearing which can be quickly removed, leaving the regular standard body. The bearings contain an eccentric mounted on the axis of the partition. They have a crank easily operated by one man to raise the gate vertically until dowel pins at the bottom are disengaged from holes in the bottom of the body and gate automatically swings open, allowing the compartment to be emptied.

The Heil Co. manufacture dump and standard bodies, extended platforms, asphalt bodies, garbage bodies, hydro hoists and improved tailgates.



RUSSELL MOTOR HI-WAY PATROL.

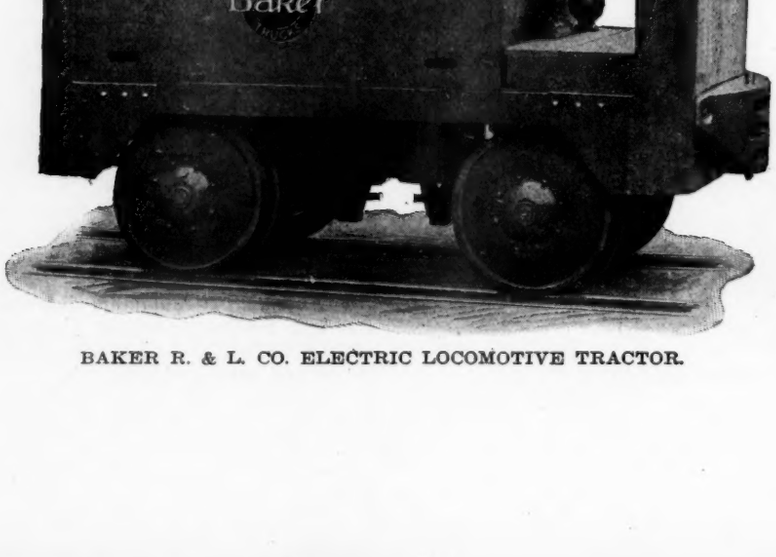
MOTOR HI-WAY PATROL

This one-man motor propelled road maintenance machine, manufactured and sold by the Russell Grader Mfg. Co., weighs 2,475 pounds, does the work of 3 teams, has a 6-foot blade and a power unit rated at from 6 to 12 h.p.

It is simple, strong and rigid in construction, having the differential and transmission housings and engine bolted direct to the central master casting which carries the drive wheel axle. It has a 6-foot well curved blade, 13½ inches wide, with detachable cutting edge. The blade is raised and lowered by worm gear, giving very speedy, accurate adjustment and automatically locking the blade in position. The normal motor speed is 1,000 rpm, developing a rated brake horse power of 12 and a rated draw bar horse power of 6. The road speed is from 1½ to 3 miles per hour, wheelbase 144 inches, tread of tractor wheels 4 feet 10 inches, tread of grader wheels 5 feet 2 inches, length 184 inches, height 6 feet, turning radius 36 feet.

ELECTRIC LOCOMOTIVE TRACTOR

The standard 4-wheel tractor built by the Baker R. & L. Co., for heavy duty service on 24 to 36-inch gage tracks, has unusual weight and strength especially adapted for operation on rails where the weight is essential to drawbar pull. It can be equipped with an Ironclad battery of 24 cells or an Edison battery of 42 cells or their equivalent in other types and weighs 3,100 pounds without battery. It is operated by a Baker series wound totally enclosed 48-volt, 60-ampere motor, rating 1,550 r.p.m., 300 per cent. overload capacity in 60 minutes. It is of the 4-wheel drive type with a drawbar pull for continuous operation of 400 pounds and of 1,000 pounds for the starting, and with a speed of 6 m.p.h. without loads and 4 1/2 m.p.h. with loads.



BAKER R. & L. CO. ELECTRIC LOCOMOTIVE TRACTOR.

AVERY TRACK RUNNER

The Track Runner built by the Avery Co. for heavy traction on difficult surfaces is 48 inches wide, 9 feet long and 58 inches high, weighs 5,000 pounds, can turn in its own length and has speeds of 2 miles, 2⅔ miles, 3½ miles per hour, at 1,000 r.p.m. of its 4-cylinder vertical motor. All of the bearings are anti-friction roller balls. The length of the track assembled is 6 feet and the width of the pad is 8¼ inches. The track has automatic lubrication and the machine is steered by the front wehels assisted by clutches. It is equipped with a 30-gallon main fuel tank and can be operated with gasoline, kerosene, distillate or alcohol.

The accompanying illustration is reproduced from page 236, issue of April 1st, where it was mistakenly used in connection with a description of the new Avery 12-20 tractor, which is built with traction wheels and without track runners.

AVERY TRACK RUNNER.

VULCAN INCINERATOR COMPANY.

The Vulcan Incinerator Co. has recently incorporated with G. P. Strelinger, president; Gilbert Mueller, vice-president and chief engineer, to sell and construct the Vulcan Incinerator under the patents of the late William McCanse, who installed very successfully odorless and smokeless plants at Durant, Ardmore and Okmulgee, Okla.

This incinerator has been built with units having domed furnace chambers about 7 feet in diameter, made of steel, concrete and fire brick, capable of withstanding 3,000 degrees of Fahrenheit and operated with initial fires of coal, oil or gas, requiring, with the forced draught system, a very small amount of fuel for the initial fires and capable of evaporating and incinerating all refuse, garbage, night soil, street sweepings, carcasses, etc., to a complete ash, free from odors.